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Farmers' perception of climate change and gender sensitive perspective for optimised irrigation in a compound surface-ground water system

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Abstract: Water is becoming a scarce resource due to the immense intensification of agricultural activity, climate change, and demographic pressure. Hence, information on water use/management and their associated management practices is essential for selecting, planning, implementing, and monitoring schemes that optimise water use to meet the increasing demand related to basic human needs and welfare. This study presents the farmers' perception of climate change from a gender sensitive perspective to promote adaptation and optimise irrigation/agricultural productivity in a compound surface-ground water system within the Anger sub-basin (Ethiopia). The study results showed that climate change affects water demand and supply routes in which more than 65% of the decrease in lake water level is due to climate change and overuse of surface water. The research findings show that women's recognition and apprehension of climate change is much greater than men's. Thus, women's role in farming is important for ensuring food security at the household level. Gender sensitivity and can play a role in preventing the change in climate through optimising irrigation efficiency and suggesting the need for further research on its application to science. The study demonstrates that women's participation in agricultural tasks, crisis management, and informal institutions is more vigorous than men's.

On the other hand, the understanding and communication of farmers is based on experience and concerns about the climate impact. Moreover, studies showed that climate change has a potential impact on the access to water supply for agriculture, urbanisation, and the environment. Therefore, there is a need to assess the dynamics of surface-groundwater interaction as affected by climate change and gender inequality to optimise the irrigation system.

Keywords: agriculture; climate change; gender-perspective; water use

INTRODUCTION

The roles of women in agriculture have been broadly studied, and the tradition of women's role in agriculture has been reported on in the perspective of the feminist theory [Drucza, Peveri 2018; McCright, Dunlap 2011; Mersha, Van Laerhoven 2018; Nelson *et al.* 2002]. The study conducted in Pakistan suggested that women's role in agriculture is highly significant [Drucza, Peveri 2018]. The demand for water and food increases pressure on environmental resources, impacting farmers' livelihoods [Hitayezu *et al.* 2017; Imburgia 2019; Pearse 2017]. People's struggles under climate change require research on whether gender is sensitive to climate change, adaptive irrigation strategy, and optimising of agricultural production. The variability and change of climate have significant consequences for the farmers, as their lives depend mainly on agriculture [Ambaw *et al.* 2019; Dawit

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et al. 2020; Di Falco *et al.* 2012]. Thus, understanding the links between gender and climate change in agriculture needs to be enhanced. The awareness of gender sensitivity to climate change in agriculture helps to differentiate its perception by men and women [Annecke 2010; Dunlap, McCright 2010; Karfakis *et al.* 2012; Pearse 2017]. The cultural perception of gender influences the management and decisions in commerce to mitigate and adapt to climate change [Ambaw *et al.* 2019; Ravera *et al.* 2019; Wang *et al.* 2020]. Moreover, gender plays a significant role in managing agricultural production and agro-biodiversity. According to Nelson *et al.* [2002], women take part in agricultural management in addition to their household responsibilities.

An integrated approach concerning gender mainstreaming in development policy is needed to challenge the gender inequalities in climate variability. Scholars suggested that men and women are not equally involved in policy development and implementation, mainly when it comes to climate adaptation [Brent 2004; Burnham, Ma 2016; Davidson *et al.* 1996; Tsige 2019]. The application of gender sensitivity to climate change and adaptation in policy development supports enhancing and promoting efforts towards efficient utilisation of the available water resources [Freudenburg, Davidson 2007; Jovanovic *et al.* 2020; Klineberg *et al.* 1998; Nelson *et al.* 2010]. Boserup *et al.* [2013] explained three types of small-scale farming systems that are mainly practiced in Africa. Practically, women's engagement level is dominant in all types: the tasks are performed almost exclusively by women, or primarily by men and by women. This policy development supports the efforts to address the vulnerability of women in climate change and its impact on socio-economic development [Annecke 2010; Conway 1996; Deressa *et al.* 2008; Dunlap, McCright 2010].

The reduction in rainfall and the increase in evaporation are observed in Ethiopia, which is one of the countries affected by climate change. Ethiopia's 1992 agricultural labour study indicated that women's contribution accounted for about 40% of agricultural production [Chamberlin, Schmidt 2012; Chiche 2005; Zewdie *et al.* 2020]. The consequences of climate change are related to the increase in the human population, which causes an increase in demand for food and water. These changes are due to poor water resource management, which includes drought, flooding, pollution, deforestation, and other forms of land degradation [Conway 2005; Dawit *et al.* 2019; Gebre *et al.* 2015; Meze-Hausken 2004]. The results come from several studies and a comprehensive assessment of losses associated with population growth, subsidence, societal interferences such as; lifestyle changes, gender, and vulnerability to the total damage both in terms of the change in climate and society's beliefs [Cohen, Young 2007; Douben *et al.* 2006; IPCC 2007; Keane *et al.* 2009].

The mitigation of poverty in developing countries needs to take into account the social norms and socio-economic conditions that regulate the implementation of environmental sustainability and the progress in poverty alleviation [Fischer *et al.* 2007; Kunkel *et al.* 1999; McNally *et al.* 2019; UN DESA 2019]. For example, the demand generated by people's basic needs and social services may increase the pressure on environmental resources, aggravating climate change [Arnell 1999; Changnon *et al.* 2000; Lemessa *et al.* 2019; Pielke, Downton 2000; Scott *et al.* 2015]. Moreover, gender-based vulnerability to climate change and the social perspective are important for defining the sustainable environment. The study of gender-based vulnerability to climate change is limited. Thus, balancing gender and the use of water during dry seasons is important and challenging. Therefore, this research proposes an idea of a holistic approach for assessing the farmers' point of view and understanding the link between gender and climate change, related to agricultural productivity at the grass-roots level.

MATERIALS AND METHODS

STUDY AREA

Anger province is located in the Wollega zone, Oromia regional state. It is one sub-basin among the Abbay river basin situated in Ethiopia's west-central part (Fig. 1). The sub-basin has an area of 7,902 km^2 with variable topography in the range of 860 and 3210 m a.s.l. The lowlands have lower altitudes below 1200 m a.s.l., and the highlands have a higher altitude greater than 3000 m a.s.l. The detailed topography of the Anger sub-basin is shown in Figure 2.

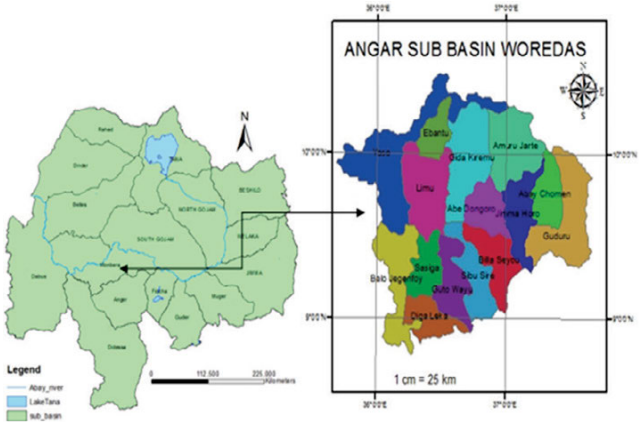

Fig. 1. Anger province location and woredas in the sub-basin; source: Nekemte… [2015]

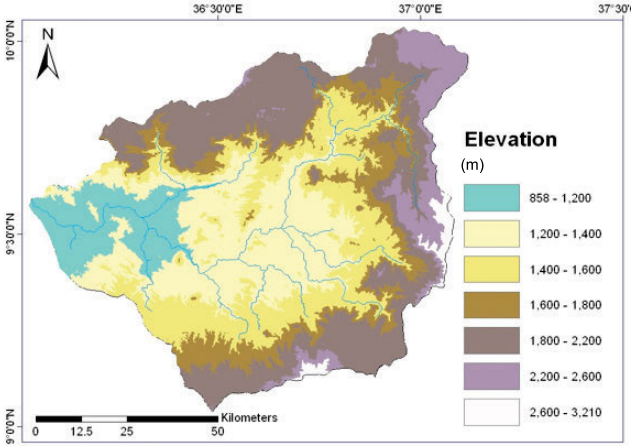

Fig. 2. The topography of Anger sub-basin; source: Nekemte… [2015]

The Anger sub-basin is west-flowing and a tributary to the Dhidhessa River, the main tributary to Abay River. The sub-basin comprises Oromia and part of Benishangul Gumuz regions. Anger river flows into the Dhidhesa river approximately half-way between Nekemte town and Cherari Village. The population

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living in the area mainly depends on agriculture, and the area is attractive for investors because the land is suitable for agricultural production. Water availability is directly linked to farm productivity, and it is influenced by climatic factors.

On the other hand, the region is dependent mainly on the farming of cash crop in the study area throughout the year. The government encourages the investors to invest in rapid development and industrialisation of agriculture to alleviate poverty and esnure food sufficiency. The Anger province's annual rainfall ranges approximately between 1280 mm and 2030 mm (Fig. 3). The rainfall observed in the province's eastern lowlands is less than 1400 mm, while the highlands have a higher annual rainfall of more than 1600 mm.

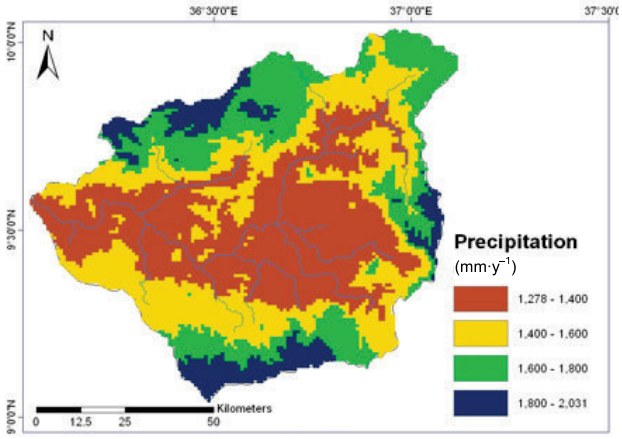

Fig. 3. Rainfall distribution in Anger sub-basin; source: Nekemte… [2015]

METHODS

Primary data collection

The primary data were collected using a questionnaire which involved an interview with the representative farmer households and a focus group discussion with the key informants and stakeholders. We performed a door to door survey data collection using the questionnaire over the period of three months. The survey was collected from 170 households selected with the application of snowball sampling techniques. About 37 households were female-headed and 133 where headed by men (about 70% of women participated in the interview). We interviewed the households using the questionnaire, and it took us about 2:30 hours to interview each household. The families were randomly selected, and the survey was conducted in four small village communities, the rural administrative villages located in the Anger sub-basin. The questionnaire included key questions such as; I) what are the main roles of men and women in agricultural production with respect to climate change, II) who is responsible for making decisions about farming and management at a household level, III) how does society (both men and women) perceive the impact of climate change on the farming system, IV) what is the farmers' perspective on climate change with respect to gender V) who is more sensitive to climate change and what is the cultural perception of gender in the society. The study was conducted in two phases, which are before dry season and during the dry season. Thus, the research contrasts tasks and women's roles associated with gender-based vulnerablity in both dry and wet seasons. The questionnaires were systematically developed and translated to the local languages (Oromiffaa) spoken by the respondents. Data collection also involved a semi-structured face-to-face household interview.

Secondary data collection

The secondary data were collected from the Oromia Water Works Bureau, zonal offices, and woreda administration bureau. Advisory literature was also collected in addition to the available data found in the study area and the secondary data obtained from each woredas of Anger sub-basin. The data collected included the size of population, land use patterns, education level, and socio-economic status at a household level. We gathered the raw data to analyse the difference among the farmers who received primary education and understand the improvement in all aspects compared to those who did not receive primary education. We also compared various findings and results in the illiteracy rate [Dowa *et al.* 2007; Mohammed 2009].

Socio-economic characterisation

The socio-economic characteristics that may influence climate change with respect to gender-sensitivity were identified [Karfakis *et al.* 2012; Narayanan, Sahu 2016]. The unreliable and inadequate rainfall has become a major threat to agricultural production [Strzepek, McCluskey 2007; Teklewold *et al.* 2017]. The economy in the province depends mainly on farming. The socio-economic evaluation indicates there is a need for small irrigation systems, which may help policymakers formulate sound policies for irrigation at the level of households. Small scale irrigation in the developing world may play a key role in drought mitigation [FAO 2000; Sadoff 2019]. The Principal Component Analysis (PCA) was implemented to generate information about the farmers' possessions at a household level [Rohde *et al.* 2017]. We divided the respondents into three groups on the basis of their assets, which included: lower-income (55%), middle-income (33%) and higher-income (12%) groups, depending on the scores.

RESULTS AND DISCUSSION

The result of the questionnaire (Fig. 4) shows that about 52% of the population are women, and 48% are men. The gender ratio and the respondent results indicate that the economic shock caused by

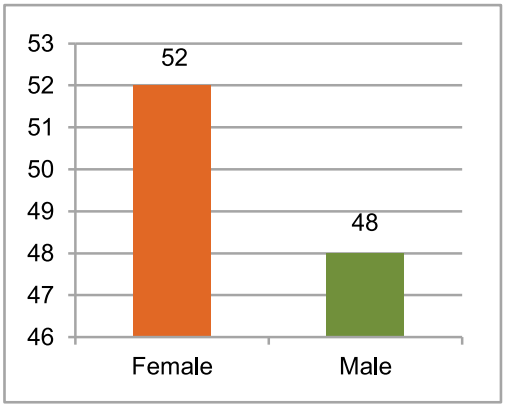

Fig. 4. Proportions between female and male population in the study area; source: own study based on the data from Woreda Administration Bureau

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climate change drives the men to migrate for employment to urban areas, while the women are left in the study area.

The livelihoods of the households in the Anger sub-basin depend mainly on the resources available within the basin, and about 52% of the households depend on agricultural production (Fig. 5). According to the results from the respondents and the report from the agricultural sector, about 47% of households are affected by climate change and the unreliability of rainfall which extends the dry season. The income earned at the household level reduces during the dry season, and mainly women are expected to take the burdens. Thus, drinking water availability reduces, which creates health hazards, and women struggle. The survey result indicates that about 90% of the households in the sub-basin are mainly dependent on rivers and developed springs to access water for household and livestock consumption.

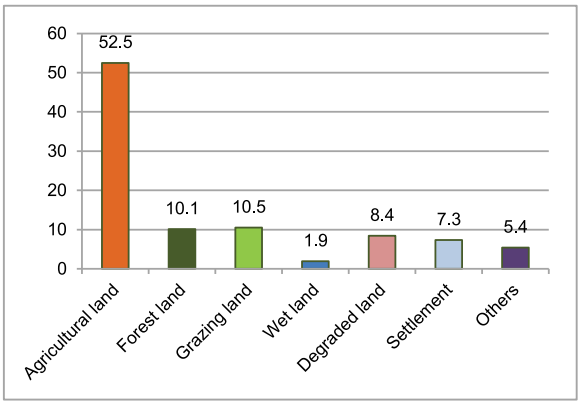

Fig. 5. Major land use patterns in Angar sub-basin; source: own study based on the data from the Agricultural Bureau

The questionnaire results show that only 12% of all respondents drink potable water from the individual household tap. About 67% of the respondents use water from the Anger river for drinking and other purposes. About 21% of the respondents acquire water from community taps developed by the government and Non-Governmental Organisations (NGOs) such as spring box and hand-dug wells. The survey results indicate women and children are mainly responsible for bringing water from the source to the household for consumption. Furthermore, the major source of water for communities in the basin, in addition to the river, are spring waters and hand-dug wells (Fig. 6). That means farmers' farming systems and livelihoods were impacted by major water-borne diseases such as malaria, infectious disease, and related diseases caused by rainfall variability, increased temperature, varying seasons, and climate change.

The secondary data collected shows that about 77% of water sources in the Anger sub-basin were untreated spring water, indicating that 84% of women and children are highly exposed to water-borne diseases and the impact of climate change. Therefore, both primary and secondary data show the direct and indirect links between gender inequality and climate change.

The results indicate that women are more sensitive to climate change than men. The trend of farmers' perceptions of climate change is mainly dependent on traditional knowledge. The study also analysed the trends in farmers' perception. Thus, the analysis of survey results on society's perception of climate change and gender sensitivity is classified into four categories:

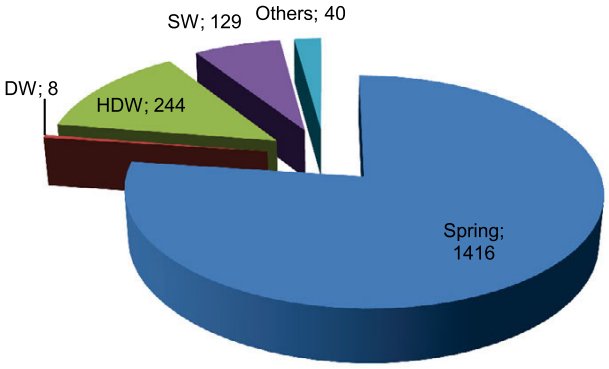

Fig. 6. Drinking water source distribution in Anger sub-basin; DW = dug wells, HDW = hand-dug wells, SW = surface water; source: own study based on the data from Anger Sub-basin Water, Mineral, and Energy Office [2015]

reduced, increased, unchanged, and not responded. The results indicate that about 73.53% of interviewed farmers perceived that, in the long term, climate change would increase, depending on the local knowledge (Tab. 1). On the other hand, the survey results show that about 77% of the interviewed women are more sensitive to climate change than men (Tab. 2).

Table 1. Farmers' perception of climate change (n = 170)

Perception	Frequency	Percentage
Reduced	30	17.65
Increased	125	73.53
Unchanged	12	7.06
Not responded	3	1.76
Total	**170**	**100.00**

Source: own study.

Table 2. The gender-based vulnerability to the climate change (n = 130)

Gender-based vulnerability	Frequency	Percentage
Less sensitive	5	3.85
Highly sensitive	100	76.92
Moderately sensitive	25	19.23
Total	**130**	**100.00**

Source: own study.

CONCLUSIONS

Understanding the links between climate change and gender inequality supports activities aimed at optimising irrigation and productivity. The farmers' perception of the links between gender inequality and climate change, where understood indirectly, indicates the need for promoting awareness and understanding among farmers. The farmers depend on rivers for purposes such as drinking, cooking, washing, and agricultural production, including livestock feeding. The study results further show that

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the province is affected by climate change. The socio-economic profile collected indicates how the change in climate affects the households' economy. Women are affected the most severely by the situation, which provides evidence of the gender-based vulnerability to climate change. During the dry seasons, males are driven to migrate to the nearby urban areas for employment, while women are left in the area, and they are forced to take responsibility for their households. The study results show that the change in climate affects the demand and supply of water in which more than 65% of the lake water level decrease is due to climate change. According to the survey results, around 85% of households depend on agriculture, which provides employment to the families and is the main source of food for their daily consumption.

The production and returns from the agricultural production at a household level decreased due to climate change, lack of improved farming systems and irrigation facilities, high input cost, and related reasons. As a result, it is recognised that the purpose of the research is to promote a gender-sensitive and integrated approach to irrigation in which more than 80% of the country's community would depend on it. Therefore, actions need to be taken by the government, pressure groups, civil societies, policymakers, and others who can propose alternative solutions. Moreover, a detailed analysis and research need to be done with regard to the links between climate change and gender inequality to come up with better recommendations and sustainable solutions.

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